Indian Journal of Animal Sciences **94** (11): 1000–1005, November 2024/Article
https://doi.org/10.56093/ijans.v94i11.155044

Farmers' preferences and breeding practices for indigenous cattle breeds in breeding tract of Karnataka

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Received: 13 August 2024; Accepted: 7 October 2024

ABSTRACT

The present study aimed to assess the breeding practices, trait preferences, and selection criteria among farmers, rearing three Indigenous Cattle (IC) breeds, i.e. *Amritmahal*, *Hallikar*, and *Malnad Gidda* in Karnataka. Data were gathered from 360 cattle owners across six districts which were the breeding tract of breeds using a semi-structured questionnaire. The findings revealed that oestrous detection is primarily identified through bellowing (95.83%) and mounting (81.39%). Breeding practices vary, with 59.72% of farmers relying exclusively on natural service (NS), while 21.67% use artificial insemination (AI). *Malnad Gidda* rearing farmers exclusively use NS, reflecting the breed's recent recognition and the limited availability of AI services. Farmers prioritise traits such as high adaptability, multi-utility, and easy maintenance, with variations specific to each breed. *Amritmahal* is valued for its multi-utility and traction power; *Hallikar* for its traction power and religious/cultural significance, and *Malnad Gidda* for its adaptability and easy maintenance. Selection of cows is heavily based on conformation traits, with udder size and pelvic width being the most critical across all breeds. The study highlights farmers' diverse preferences and practices, shaped by the distinct characteristics and utilities of each IC breed. These insights can guide breeding programs and policy decisions focussed on preserving and enhancing indigenous cattle breeds.

Keywords: Breeding practices, Indigenous cattle, Livelihood, Preferential traits

Cattle have long played a central role in agriculture, contributing significantly to livelihoods, culture, and food security worldwide (Kolekar *et al*. 2023). India, home to approximately 193.46 million cattle, holds 14.5% of the global cattle population and accounts for over a third (36.04%) of the country's total livestock numbers (DAHD 2022). Indigenous cattle (IC) constitute 73.45% of the total cattle population in India, amounting to 142.11 million. With 53 recognized cattle breeds, India has the largest variety of cattle breeds globally (ICAR 2024). These IC are not only providers of milk, dung, and draught power, but are also integral to India's ecological heritage (Bhandari *et al*. 2022). They are deeply embedded in the traditions and livelihoods of communities and are crucial to the cultural heritage of livestock farmers.

Despite their significance, modern farming threatens IC resources including non-exploitation of the potential of IC, random crossbreeding with exotic breeds, urbanisation and market shifts (Selvan *et al*. 2022). Youth's disinterest in crop-livestock agriculture and the inability to pass down animal keeper knowledge to the next generation leads to a loss of cultural identity and heritage when breeds go extinct (Li *et al*. 2024). Decreasing trend in the IC population, necessitates documentation of farmers' preferences and breeding practices at the household level. This knowledge is critical from the perspective of conservation and development of IC, essential for the food security of millions of farmers, and to formulate future research strategies on cattle breeding.

Previous studies on farmers' preferential traits in rearing IC were typically localized, such as those by Ouma *et al*. (2005) on IC in Kenya, Ngowi *et al*. (2008) on *Tarime zebu* cattle in Tanzania, Msanga *et al*. (2012) on IC in Tanzania, and Tada *et al*. (2013) on *Nguni* cattle in southern Africa. Considering the need for a comprehensive study covering a larger area and focussing on specific IC, this explorative study examined livestock keepers' cattle breeding practices and preferred traits within their breeding tract.

MATERIALS AND METHODS

Study area and breeds selection: This study was conducted in Karnataka, India. The state is home to six native cattle breeds: *Amritmahal*, *Deoni*, *Hallikar*, *Khillar*, *Krishna Valley*, and *Malnad Gidda*. The study specifically selected three cattle breeds, namely *Amritmahal*, *Hallikar*, and *Malnad Gidda* found only within Karnataka (ICAR 2024).

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Sampling procedure: The study was undertaken in six districts of Karnataka, with two districts representing the breeding tract of each IC breed. A combination of purposive and random sampling strategies was employed to gain focussed insights and ensure representativeness. Chikkamagaluru and Chitradurga districts represented the *Amritmahal* breed, Mandya and Hassan districts represented *Hallikar*, and Shivamogga and Uttara Kannada districts represented the *Malnad Gidda* breed (Fig. 1). Two blocks/talukas with the highest density of IC breeds were selected from each district. From each block, three village panchayats were chosen, totaling 36 village panchayats. From each panchayat, ten household heads rearing at least two ICs above one year of age were selected, resulting in a sample size of 360 cattle owners.

Selection of respondents: One adult member or head of the household actively engaged in managing ICs was selected as the respondent from each household. Before interviews, participants' informed consent was taken.

Data collection: Semi-structured questionnaires were developed and translated into local language. It was pre-tested and adjusted based on respondents' feedback to ensure that it met research goals and was comprehensible. A team of trained enumerators administered the questionnaire, with the researcher's supervision to ensure proper data collection.

Data management and analysis: The collected data underwent a thorough process of checking, coding, and computer entry for further analysis. Descriptive statistics were generated using the Statistical Analysis System (SAS version 9.2) Windows version (SAS 2022). Additionally, the Statistical Package for Social Sciences (SPSS version 20) Windows version (SPSS 2022) was used to obtain frequency distributions.

Indices were calculated to rank trait preferences and selection criteria, in indigenous cattle rearing. The formula used to compute the index was:

$$\text{Index} = \frac{\sum[(R_n \times C_1)+(R_{n-1} \times C_2)+(R_n \times C_1)+\ldots\ldots(R_1 \times C_n)] \text{ for specific variable}}{\sum[(R_n \times C_1)+(R_{n-1} \times C_2)+(R_n \times C_1)+\ldots\ldots(R_1 \times C_n)] \text{ for overall variable}}$$

where, R_n, the last rank (example if the last rank is 8th, then $R_n = 8$, $R_{n-1} = 7$, $R_1 = 1$); C_n, Number of respondents ranked last; C_1, Number of respondents ranked first.

RESULTS AND DISCUSSION

Livestock profile of the respondents: IC holdings among farmers ranged from 1.60 to 6.52 Adult Unit Equivalent (AUE), with an average of 3.85 AUE. Among the three breeds studied, the *Malnad Gidda* was preferred, with an average herd size of 5.14±0.21 AUE. This breed is particularly valued for its resilience, small frame, and manure production capabilities.

Farmers had an average experience of 22.79±0.43 years in cattle rearing, varying between 6 to 41 years. Most of these farmers were old and middle-aged indicating the traditional knowledge and experience passed down through generations. Over 90.00% of farmers kept more than one type of livestock, while only 9.17% exclusively reared indigenous cattle. The results reflected a concerning trend

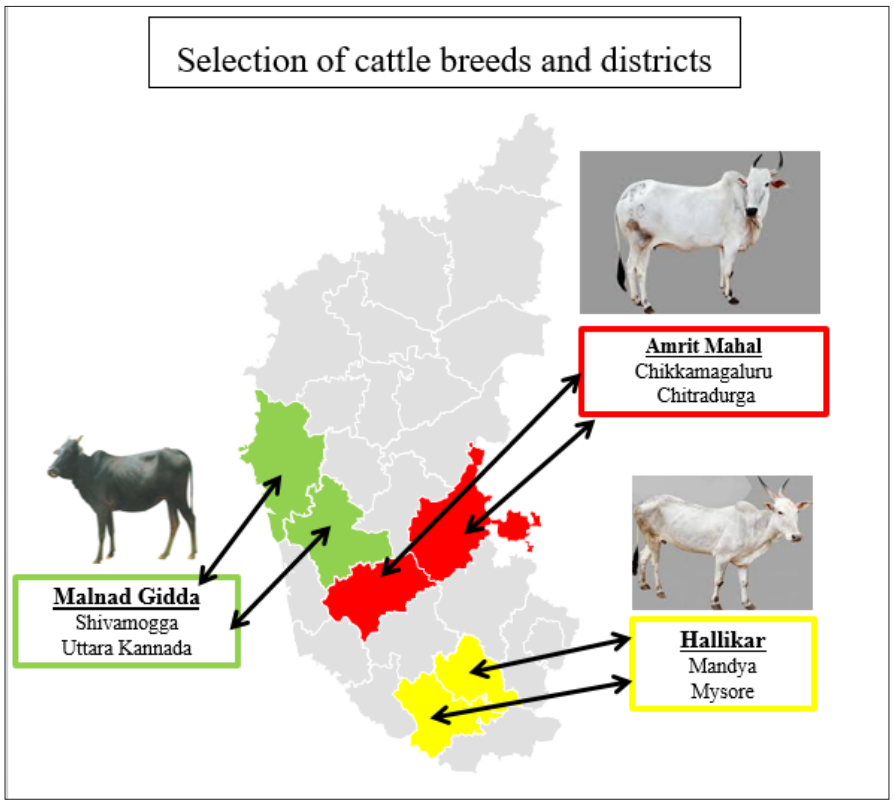

Fig. 1. Selection of districts and breeds.

Table 1. Breeding management practices in rearing indigenous cattle

Breed	*Amrithmahal* (n_1=120)	*Hallikar* (n_2=120)	*Malnad Gidda* (n_3=120)	Pooled (n=360)
*Oestrous detection/ Heat detection methods**				
Bellowing	118(98.33)	117(97.50)	110(91.67)	345(95.83)
Restlessness	95(79.17)	91(75.83)	100(83.33)	286(79.44)
Frequent urination	76(63.33)	78(65.00)	56(46.67)	210(58.33)
Mounting	97(80.83)	103(85.83)	93(77.50)	293(81.39)
Vaginal discharge	81(67.50)	86(71.67)	94(78.33)	261(72.50)
Breeding method				
Only NS	46(38.33)	49(40.83)	120(100.00)	215(59.72)
Only AI	36(30.00)	42(35.00)	0(0.00)	78(21.67)
Either NS/ AI	38(31.67)	29(24.17)	0(0.00)	67(18.61)
*Natural service with the bull***				
Govt. Provided bull	12(14.29)	20(25.64)	4(3.42)	36(12.90)
Bull reared by the farmer	66(78.57)	55(70.51)	48(41.03)	169(60.57)
Any stray bull	6(7.14)	3(3.84)	65(55.56)	74(26.52)
Time of Insemination/Natural service				
Immediately after notice of oestrous symptoms	51(42.50)	78(65.00)	99(82.50)	228(63.33)
After 6 hrs of oestrous onset	45(37.50)	12(10.00)	21(17.50)	78(21.67)
After l2 hrs of oestrous onset	24(20.00)	30(25.00)	0(00.00)	54(15.00)
Castration of indigenous cattle bull				
Yes	78(65.00)	102(85.00)	63(52.50)	243(67.50)
No	42(35.00)	18(15.00)	57(47.50)	117(32.50)
Pregnancy diagnosis by rectal examination				
Followed	63(52.50)	61(50.83)	21(17.50)	145(40.28)
Not followed	57(47.50)	59(49.17)	99(82.50)	215(59.72)
*Criteria for selection of bull for natural service***				
Physical appearance	42(50.00)	38(48.72)	20(17.09)	100(35.84)
Pedigree	5(5.95)	12(15.38)	4(3.42)	21(7.53)
Livestock show winner	6(7.14)	3(3.85)	2(1.71)	11(3.94)
Reliability of owner	21(25.00)	18(23.08)	65(55.56)	104(37.28)
Charges	10(11.90)	7(8.97)	26(22.22)	43(15.41)

Figures in parenthese(s) indicate percentage. *, Multiple responses; **, Out of the total respondents who prefer natural service in animal.

in the dwindling population of IC, which has decreased by 37.71% (Behl *et al.* 2023). This decline is largely due to farmers' aversion to IC, owing to the efforts required to maintain pure indigenous breeds amidst dynamic agricultural practices (Kolekar *et al.* 2023).

Breeding practices in rearing IC: The study examined various breeding practices among respondents, focussing on methods for oestrous detection, breeding, the timing of insemination, castration practices, pregnancy diagnosis, and criteria for bull selection. As indicated in the Table 1, the majority of respondents (95.83%) identified oestrous through bellowing, followed by mounting (81.39%), restlessness (79.44%), vaginal discharge (72.50%), and frequent urination (58.33%). This indicates that oestrous symptoms in IC are highly noticeable. In terms of breeding methods, 18.61% of respondents used both natural service (NS) and artificial insemination (AI), 21.67% relied solely on AI, and 59.72% preferred NS. Notably, 100% of *Malnad Gidda* breeders used NS exclusively. The study highlighted that AI adoption in *Hallikar* and *Amrith Mahal* was 35.00% and 38.33%, respectively. *Malnad Gidda*'s reliance on NS was attributed to its recent breed status and the introduction of AI semen only in 2015, with costs significantly lower than NS services.

The timing of insemination was crucial, with 63.33% of respondents opting for immediate breeding after noticing oestrous, while 21.67% waiting 1 to 6 h, and 15.00% delayed until 7 to 12 h. Castration was practiced for non-breeding males primarily for draught purposes. Pregnancy diagnosis by rectal examination was not common, practiced by only 40.28% of respondents. Bull selection for NS was mainly based on the reliability of the owner (37.28%) and physical appearance (35.84%), with lesser emphasis on the cost, pedigree, and livestock show success. This study highlighted traditional practices' prevalence and the gradual adoption of modern breeding methods among indigenous cattle breeders.

Farmer's preferential traits of IC breeds: The study examined farmers' preferences for various traits in three IC breeds-*Amritmahal, Hallikar*, and *Malnad Gidda* and

Table 2. Preferential traits and their Ranking index for selected breeds

Preferential trait	*Amrithmahal* (n_1=120)		*Hallikar* (n_2=120)		*Malnad Gidda* (n_3=120)	
	Index	Order	Index	Order	Index	Order
Multi-utility	14.75	1	12.52	6	13.31	3
Traction power	14.58	2	14.24	1	13.20	4
High adaptability	13.31	3	13.29	3	14.53	1
Religious/cultural sentiment	13.26	4	13.87	2	12.02	6
Easy maintenance	11.69	5	13.22	4	13.84	2
Quality milk and milk products	11.53	6	12.57	5	10.00	7
Temperament	10.63	7	9.75	8	9.93	8
Disease resistance	10.25	8	10.56	7	13.17	5

Index= sum of (8 times first order + 7 times second order + 6 times third order + 5 times fourth order + 4 times fifth order + 3 times sixth order + 2 times seventh order + 1 times eighth order) for individual variables divided by the sum of (8 times first order + 7 times second order + 6 times third order + 5 times fourth order + 4 times fifth order + 3 times sixth order + 2 times seventh order + 1 times eighth order) for all variables.

highlighted the significance of these traits in guiding breeding and management decisions.

Table 2 shows that for the *Amritmahal* breed, multi-utility is the most preferred trait, underscoring the breed's versatility in fulfilling multiple roles such as draught power and milk production. Traction power ranks second, reflecting the breed's historical use as a draught animal. High adaptability and religious/cultural sentiments showed that these animals were valued not only for their functional roles, but also for their adaptability and cultural importance. Traits such as easy maintenance and quality milk and milk products were also considered, though they rank lower, indicating a more secondary role in the selection process. Temperament and disease resistance were the least prioritized traits for *Amritmahal,* highlighting a focus on productivity over behavioural or health-related characteristics.

In the *Hallikar* breed, traction power was the top priority, emphasizing the breed's primary role as a draught animal. Religious/cultural sentiment ranked second, reflecting the breed's deep-rooted cultural significance. High adaptability and easy maintenance also rank high, indicating the breed's ease of care and ability to thrive in various environments. However, quality milk and milk products and multi-utility traits ranked lower, suggesting that these traits are not the primary focus for *Hallikar* farmers. Disease resistance and temperament were the least preferred traits, showing a similar pattern to *Amritmahal* in terms of lower emphasis on health and behaviour.

For the *Malnad Gidda* breed, high adaptability was the most preferred trait, reflecting the breed's ability to thrive in the rugged and hilly terrains of its native region. Easy maintenance and multi-utility are also highly valued, showing the breed's practicality and versatility. Unlike the other breeds, religious/cultural sentiment was less emphasized and quality of milk and milk products along with temperament were ranked lowest, indicating that milk production and behaviour were not primary concerns for *Malnad Gidda* farmers.

When analysing the pooled data in Table 3, high adaptability emerged as the most preferred trait across all breeds, reflecting a common preference for IC that can thrive in various environments. Multi-utility and easy maintenance are also highly valued, emphasizing the need for versatile and low-maintenance animals. However, traction power and religious/cultural sentiment showed that functional and cultural roles were still important factors. Quality milk and milk products, disease resistance,

Table 3. Preferential traits of breeds in rearing IC of Karnataka

Preferential trait	Order of trait preference									
	1st	2nd	3rd	4th	5th	6th	7th	8th	Index	Order
High adaptability	47	65	65	52	53	14	22	42	14.05	1
Multi-utility	32	78	30	79	64	21	26	30	13.72	2
Easy maintenance	64	33	68	25	38	29	42	61	12.81	3
Traction power	53	53	28	36	65	32	38	55	12.58	4
Religious/cultural sentiment	41	38	49	34	51	53	56	38	12.12	5
Quality milk and milk products	45	38	28	37	48	63	62	39	11.75	6
Disease resistance	45	25	46	55	13	76	56	44	11.74	7
Temperament	33	30	46	42	28	72	58	51	11.23	8

Index= sum of (8 times first order + 7 times second order + 6 times third order + 5 times fourth order + 4 times fifth order + 3 times sixth order + 2 times seventh order + 1 times eighth order) for individual variables divided by the sum of (8 times first order + 7 times second order + 6 times third order + 5 times fourth order + 4 times fifth order + 3 times sixth order + 2 times seventh order + 1 times eighth order) for all variables.

Table 4. Ranks of conformation traits used for selecting Indigenous breed cows

Variable	*Amrithmahal* (n_1=120)		*Hallikar* (n_2=120)		*Malnad Gidda*	
	Index	Order	Index	Order	(n_3=120)	Order
Udder size	19.72	1	21.19	1	17.70	2
Pelvic width	19.66	2	19.45	2	17.84	1
Teat size	15.91	3	15.69	3	16.95	3
Wither height	16.68	4	15.83	4	15.72	4
Body length	12.69	5	13.67	5	15.30	5
Dewlap size	15.34	6	14.16	6	16.49	6

Index= sum of (6 times first order + 5 times second order + 4 times third order + 3 times fourth order +2 times fifth order + 1 times sixth order) for individual variables divided by the sum of (6 times first order + 5 times second order + 4 times third order + 3 times fourth order + 2 times fifth order + 1 times sixth order) for all variables.

and temperament were less emphasized overall, suggesting that while important, they were secondary to the more functional and adaptive traits.

Several researchers reported similar results, viz. Silva *et al.* (2006), Pen *et al.* (2009), Radder *et al.* (2010), Siddiquee *et al.* (2013), Chenyambuga and Lekule (2014) that IC are valued by farmers for the convenience of feeding, draft animal power, resistance to diseases, adaptability, milk quality, monetary advantages, and cultural requirements.

Selection practices: All respondents indicated that the selection of female cattle is primarily based on anticipated milk production potential. Farmers used body conformation and the performance history of the animal's linkage. Both individual and focus group participants stressed the importance of conformation traits in selecting high-yielding milking cows. Six key conformation traits were observed and prioritised by the participants as showed in Table 4. The ranking order of these traits varied across different breeds, as reflected by the percentage index.

The study revealed that farmers employed specific conformation traits to select cows for their milk production potential, with notable differences across the *Amritmahal*, *Hallikar*, and *Malnad Gidda* breeds. These traits included udder size, pelvic width, and teat size, wither height, body length, and dewlap size. The ranking of these traits varied by breed, reflecting the unique selection practices of farmers for each breed. For the *Amritmahal* breed, udder size emerged as the most critical trait, followed closely by pelvic width. This suggested that farmers prioritized these traits for their direct impact on milk production. Teat size and wither height also played significant roles, while body length and dewlap size were less emphasized.

In the *Hallikar* breed, udder size ranked highest, indicating its importance across breeds. Pelvic width was similarly valued, followed by teat size and wither height. Body length and dewlap size were considered to a lesser extent. In *Malnad Gidda* breed, pelvic width was the top priority, reflecting a different selection focus compared to the other breeds. These results highlighted the nuanced selection practices tailored to each breed's characteristics, emphasizing the importance of conformation traits in dairy cow selection to optimize milk production and overall livestock quality.

The study provided farmers' breeding practices and trait preferences knowledge which indicated a clear divergence in the approach toward different breeds. The exclusive reliance on NS for *Malnad Gidda*, for example, underscored the breed's recent recognition and the limited availability of AI services tailored to rare small-sized breed. This suggested a strong preference for maintaining the breed's genetic integrity, which is crucial for preserving its adaptability to the local environment. Farmers' preferences for high adaptability, multi-utility, and traction power reflected their practical needs in agricultural systems, where cattle are not only sources of milk and meat, but are also key to draught power and other farm-related activities. The trait preference was not just economically driven, but also tied to cultural and religious sentiments, particularly in *Hallikar* cattle, which are historically revered for their association with religious ceremonies.

The present investigation also identified specific conformation traits that farmers prioritize when selecting cows, such as udder size and pelvic width. These traits are closely linked to reproductive efficiency and milk production, indicating that despite the multi-utility value of these cattle, productivity remains an essential criterion for selection. However, the reliance on traditional knowledge for trait selection and breeding practices, while beneficial for maintaining breed purity, could limit the potential for genetic improvement and productivity enhancement.

ACKNOWLEDGEMENTS

This research is part of Ph.D. thesis submitted to the ICAR-National Dairy Research Institute, Karnal, Haryana. The authors are grateful to the ICAR-National Dairy Research Institute, Karnal, Haryana, for providing the resources and necessary support to complete this research.

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